ATS Concept of Operations
for the National Airspace System in 2005

Narrative

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Air Traffic Services

CONCEPT OF OPERATIONS
for the National Airspace System in 2005

Foreword

This document describes the needs of the service provider in 2005, and addresses methods and procedures necessary for the efficient evolution of the National Airspace System and for the implementation of Free Flight. This overview concept is intended to be used as the basis for procedural, architectural, and investment plans and decisions, and will be coordinated in a collaborative manner with industry stakeholders.

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Acronym List

AAT	Air Traffic Service
ADIZ	Air Defense Identification Zone
AOC	Aeronautical Operational Control
ARS	Air Traffic Service Requirements Service
ASD	Office for System Engineering and Development
ATIS	Automated Terminal Information Service
ATM	Air Traffic Management
ELT	Emergency Locator Transmitters
FAA	Federal Aviation Administration
FIS-B	Flight Information Services Broadcast
FMS	Flight Management System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
NAS	National Airspace System
NOTAM	Notice to Airmen
O&M	Operations and Maintenance
RNAV	Area Navigation
SUA	Special Use Airspace
VFR	Visual Flight Rules
VHF	Very High Frequency

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1. INTRODUCTION

This document describes a high level concept of operations for the National Airspace System (NAS) in the year 2005. It is accompanied by a lower level concept document, currently in draft form, that describes operational tasking in En Route and Arrival/Departure control facilities.[1] These documents have been developed for the Federal Aviation Administration (FAA) Air Traffic Services (ATS), with support from the organizations of the Associate Administrators for Certification & Regulation, and Research & Acquisition. This broad support within the FAA reflects the continued migration of the NAS from a ground-based infrastructure to one that encompasses both ground and airborne systems (1.2).The participation of these organizations also demonstrates recognition of the need to engage the acquisition components of the FAA early in the concept formulation process.

1.1 BACKGROUND

In the fall of 1996, ATS issued the second edition of the *Air Traffic Service Plan* to facilitate an ongoing dialogue between the air traffic service organizations and airspace users. This dialogue is intended to develop a clear understanding of user needs, and to provide the air traffic services necessary to meet them. Specifically, the Plan reflects the joint efforts of the FAA and Industry, through RTCA, to implement Free Flight. Its primary purpose is to highlight the views of the aviation community, focusing on changes that must be made in order to combine increased user flexibility with operating efficiencies under increased levels of system capacity and safety. This document, *A Concept of Operations for the National Airspace System in 2005,* describes an air traffic environment which provides that flexibility and efficiency through development of a global airspace system incorporating the International Civil Aviation Organization's communication, navigation and surveillance (CNS/ATM) concept (1.5).

It is important to remember that the current NAS continues to reflect its origins as a system in which aircraft flew directly between navaids along FAA defined routes. As a result, the current NAS airspace structure reflects constraints that the navigation, communications, and computer systems imposed. To meet the emerging user needs for greater flexibility in planning and conducting flight operations, the air traffic system must evolve in the areas of airspace and procedures, roles and responsibilities, equipment, and automation (1.7). This operational concept describes the NAS architectural decisions and strategies needed to guide this evolution.

1.2 SCOPE AND INTENDED USE

This document presents a high-level description of air traffic operations in 2005. This time frame represents the first opportunity to make fundamental changes in the delivery of NAS services. Therefore, the concepts provided here do not describe an end-state system. Instead, they define that initial change in the air traffic environment, and lay the groundwork for transitional phases subsequent to 2005. These transitional phases will expand on the concepts described here, and, building upon 2005 technologies, culminate in an end-state system.

- FAA Air Traffic Service (AAT) and FAA Airway Facilities Service (AAF) will use this document as a source to define NAS operational needs and to guide improvements in NAS infrastructure management.
- FAA Air Traffic Service Requirements Service (ARS) will use this document as a source to define requirements and influence investment decisions.
- FAA Aircraft Certification Service (AIR) and FAA Flight Standards Service (AFS) will use this document as a source to develop certification and regulation guidelines, to support certification of new systems, and to develop standards to implement the shared infrastructure of 2005.
- FAA Office for System Engineering and Development (ASD) will use this document as a source to define the NAS architecture of 2005.

[1] Reference *ATS Concept of Operations for the National Airspace System in 2005: Controller Task Models, Non-Sector Task Descriptions, and Operational Scenarios.*

Since any operational concept must be grounded in reality, this document will be subject to ongoing evaluation and validation. It will be modified to reflect the results of those efforts to provide a detailed definition and analysis of the concepts. Throughout this process, the FAA and the user community will use the maturing concepts to coordinate activities related to the development and implementation of air traffic services and operational capabilities within the NAS. These concepts will also be used to coordinate and define FAA policies, and will be updated to reflect changes in FAA strategy.

This document is written primarily from the perspective of the NAS service provider. The term "service provider" refers to any ATS employee who provides separation assurance, traffic management, airspace management, aviation information, search and rescue, aviation assistance, or navigation/landing services to NAS users. The terms "User" and "NAS User" refer to any customer that uses the air traffic system, including air carriers, general aviation (GA), and Department of Defense (DOD).

1.3 CHARACTERISTICS OF THE NAS IN 2005

2005 sees the completion of the National Airspace Review, the replacement of the "Host" en route automation system, the transition to satellite navigation, and the introduction of new display platforms (1.9). It marks the end of the *first phase* of transition to the technologies and airspace structures required for Free Flight. With some of these technologies fully deployed, and others under limited deployment, subsequent development is under way to complete the transition to a full Free Flight environment in the post-2005 era] (1.10)).

The NAS in 2005 takes a human-centered approach to maximize the efficient delivery of air traffic services to users (1.11). Thus system processes and workstations are designed to expedite the exchange of information between NAS information systems, service providers, and users (1.12). Human factors analyses and human-in-the-loop simulations have determined the appropriate allocation of tasks between service providers, users, and automation systems (1.13). Moreover, issues such as situation awareness, workload, and computer-human-interface (CHI) design have been resolved by incorporating human factors and operational assessments throughout the NAS design and validation process (1.14).

As a result of the new systems in place in 2005, traffic demand has increased significantly without a corresponding increase in the controller workforce (1.15). Controller workload under peak traffic remains equivalent to the workload controllers absorbed in the 1990s under lighter traffic demand. This increased ATC efficiency has been achieved through the implementation of decision support systems for traffic management and control, dynamic alteration of airspace boundaries, reduced vertical separation minima, improved air/ground communications and coordination, and enhanced ground/ground coordination aids (1.16). Air safety has been increased through the implementation of conflict detection and resolution tools, the inclusion of the flight deck in some separation decision-making, and greatly enhanced weather detection and reporting capabilities (1.17). Due to these improvements, the NAS in 2005 is marked by the following key characteristics:

- *Phased Technology Implementation*. The evolution of the operational environment is based on an incremental implementation of new technologies. This approach maintains safety as the first priority, while also increasing capacity, efficiency, and flexibility in a balance with environmental considerations (1.19). The ATS organization regards community involvement as an essential element in the development of procedures and the establishment of facilities.

- *Redistributed Roles and Responsibilities*. Separation assurance remains the responsibility of the service provider. However, that responsibility is shifted to the flight deck for specific operations (1.20).

- *Human Factors Considerations.* The evolution of the NAS utilizes a clear transition strategy for each operational capability, and employs a human-centered approach for implementing new operational concepts and supporting technologies (1.21). This approach ensures that the human capabilities and limitations of users and service providers remain a primary consideration in systems development (1.22).

- *Information Distribution.* A NAS-wide information system distributes timely and consistent information across the NAS, for both user and service provider planning (1.23). This information system serves as an avenue for a greater exchange of electronic data and information between users and service providers. The system contains the following information (1.24):

- Static data such as maps, charts, airport facility guides, and published Notices to Airmen (NOTAMs)
- Dynamic information such as current and forecast weather, radar summaries, hazardous condition warnings, information on updated airport and airspace capacity constraints, and special use airspace (SUA) schedules.
- Flight information on each flight including the filed flight profile and all amendments, first movement of the aircraft, wheels-up, position data in flight, touchdown time, gate or parking assignment, and engine shutdown.
- Schedule information which is updated throughout the day to reflect changes in carrier operations.

- *Airspace Boundary Adjustments.* With the reduction of the computational and communications barriers of the past, airspace design and underlying sector configurations are no longer constrained by the current geographic boundaries, particularly in high altitude (1.25). Upon completion of the National Airspace Review, tools and procedures are in place for frequent evaluation (up to several times a day) of the airspace structure and anticipated traffic flows, with adjustments made accordingly (1.26). Due to this increased flexibility, the number and scope of air traffic facilities may be modified to support dynamic traffic factors, rather than institutional requirements (1.27).
- *Seamless Communications.* Automation systems support the dynamic airspace structure with seamless inter- and intra-facility communication and coordination (1.28).
- *Airspace Flexibility.* Seamless communications and coordination, coupled with the NAS wide information system, allow for the dynamic reassignment of airspace between facilities to meet contingencies such as equipment outages (1.29).
- *Collaborative Decision-Making.* The system allows increased collaboration between users and service providers for resolving strategic problems (1.30). For situations such as demand-capacity imbalances or severe weather, this capability supports collaboration in determining when, where, and how to transition to temporary route structures to meet a short-term problem.
- *Fault-Tolerant Systems.* The NAS is a fault tolerant system, designed through safety and risk analysis to identify areas requiring higher reliability and backup (1.31). Since it is recognized that systems will fail, the NAS design maintains a balance between reliability, redundancy and procedural backups. Thus the design provides a system which is not only available but one that also requires minimal time to restore failed functionalities.
- *Automation Aids.* Automation aids enable the elimination of paper flight strips throughout the NAS (1.32). Aircraft progress is tracked electronically with all critical functions provided for in the backup system (1.33a). There is also an increased usage of decision support systems that provide both information and heuristics to support the providers in their tasks (1.33b). These tools reduce the burden of routine tasks while increasing the provider's ability to evaluate traffic situations and plan the appropriate response. This increases productivity and provides greater flexibility to user operations, which is especially important given the potential for reduced vertical separation minima and increased traffic density (1.34).
- *Timely Implementation of Procedures.* Just-in-time operating procedures for the service providers and users will accommodate the transition to, and operations in, 2005. Procedural changes are developed, evaluated, and instituted to meet technology as it arrives, rather than post-deployment (1.35).
- *Infrastructure Management.* There are improved methods for collecting and processing NAS infrastructure data. These data, available as an integral part of the NAS wide information system, are used to prioritize and schedule NAS infrastructure activities (1.36). Users and service providers collaborate in this prioritization and scheduling, utilizing decision support tools that provide information regarding the coverage and status of NAS infrastructure components (1.37).
- *Enhanced Weather Information.* There is increasingly accurate weather data available to the service

provider and user (1.38). These data include hazardous weather alerts for wind sheer, microbursts, gust fronts, and areas of precipitation, icing, and low visibility. Enhanced steps for avoiding convective weather are made as weather tools are improved and integrated into the decision support tools (1.39).

- *NAS Performance Measurement.* There are improved methods and tools to measure NAS performance and to identify user requirements, including the daily archiving of the NAS wide information system. These improvements are geared toward providing the information in a meaningful and readily accessible form (1.40).
- *Operational Supervision.* The operational supervisors are key players in providing the flying public and aviation community the services they expect and deserve. They provide the primary management presence in the operational area, enabling people and highly technical systems to collaborate in achieving desired outcomes and results (1.41).
- *Facility Management.* Managers are provided with appropriate decision support systems to manage budgets, staff, and costs (1.42). These decision support systems provide information to resolve short-term problems, such as staffing imbalances, and more strategic management of personnel and resources.

The remainder of this document describes these characteristics in greater detail, but remains at a high level to convey the general operational concepts and the context in which they are applied.

1.4 ORGANIZATION

To convey a meaningful concept of operations, this document is organized by the sequence that users follow to plan and conduct a flight through the air traffic system.

- *Section 2* describes the operations required to plan a flight and obtain a departure clearance.
- *Section 3* describes operations for airport surface ATM.
- *Section 4* describes operations for departures and arrivals.
- *Section 5* describes operations in the en route or cruise phase of flight.
- *Section 6* describes oceanic operations.
- *Section 7* describes the management of NAS traffic flows and infrastructure.
- *Section 8* addresses the management structure for Air Traffic Services in 2005.

2. FLIGHT PLANNING OPERATIONS AND SERVICES

In order to meet user requirements in 2005, the static and repetitive flight plan process currently used by service providers is enhanced to provide a collaborative interaction with the user. This interaction creates dynamic, event-driven user-preferred trajectories for individual flights (2.1). These flight planning operations are characterized by the following:[2]

- Elements of the NAS-wide information system are used to obtain and distribute flight-specific data and aeronautical information, including international coordination of flight trajectory content (2.2).
- Real-time trajectory updates reflect more realistic departure times, resulting in more accurate traffic load predictions, and increased flexibility due to the imposition of fewer restrictions (2.3).
- Interactive aids facilitate a more collaborative role for users in obtaining NAS information in order to improve their ability to execute the flight plan (2.4). Examples of this information include current and predicted status of SUAs, infrastructure status, traffic density, and prevailing traffic flow initiatives.
- Standardized domestic and international trajectory information improves the interaction between the NAS, NAS users, and domestic and international service providers (2.5).

2.1 ENVIRONMENT

The year 2005 sees significant changes in the planning data available to users, and in the flight plan itself. In today's planning process, the planner refers to a variety of sources for static information regarding terrain, airways and airports. They also utilize dynamic information concerning weather, radar summaries, hazardous condition warnings, airport and airspace capacity constraints, SUA schedules, and the status of NAS infrastructure components. In 2005, planners and service providers have automated access to this information from the continuously and automatically updated NAS-wide information system. The scope of information is expanded to include items such as (2.7):

- Real-time information on the status of SUAs
- Real-time status of the NAS infrastructure
- Predictions of traffic density based on the current flight trajectories, both filed and active
- Current and planned dynamic route structure and associated transition points.
- DoD access to information regarding aircraft which will enter the Air Defense Identification Zone (ADIZ).

As a result of these improved planning capabilities, today's flight plan is replaced by a *flight profile*. This profile can be as simple as the user's preferred path, or as detailed as a time-based trajectory that includes the user's preferred path and preferred climb and descent profiles (2.8). The flight profile is a part of a larger data set called the *flight object*. This data set is available throughout the duration of the flight, both to the user, and to service providers across the NAS (2.9). For an appropriately equipped aircraft operating under visual flight rules (VFR), the flight object contains the flight path, a discrete identification code that provides precise location and identity information, and all necessary information to initiate search and rescue. For a flight operating under instrument flight rules (IFR), the flight object can be a much larger data set, including a preferred trajectory coordinated individually by the user, and supplemental information such as the aircraft's current weight, position, runway preference, or gate assignment. Flight object information can be updated by the user or service provider throughout the flight (2.10).

2.2 FLIGHT PLANNING OPERATIONS AND SERVICES

The 2005 flight planner interacts with the NAS-wide information system to create a flight profile. This action initiates the automatic generation of a flight object containing either the user's preferred flight path

[2] This section presents a high-level description of flight planning operations and services in 2005. This time frame represents the first opportunity to make fundamental changes in the delivery of NAS services. Therefore, the concepts provided here do not describe an end-state system. Instead, they define that initial change in the air traffic environment, and lay the groundwork for transitional phases subsequent to 2005. These transitional phases will expand on the concepts described here, and, building upon 2005 technologies, culminate in an end-state system.

or a more detailed time-based flight trajectory (2.11). As conditions change during the planning phase, or during the flight, the planner continues to access the NAS-wide information system to determine the impact of the changes on the flight (2.12). This information is electronically available to all service providers until the termination of the flight (2.13). Information such as runway preferences and aircraft weight, or information to support flight following can be added during the planning phase or during the flight (2.14).

As the planner interactively generates the flight profile, information regarding current and predicted weather conditions, traffic density, restrictions and status of SUAs is available (2.15) to improve the efficiency of the task. When the profile is filed, it is automatically checked against these conditions and any static constraints such as terrain and infrastructure advisories (2.16). Potential problems are automatically displayed to the planner for reconciliation. Upon filing, the flight object is updated as necessary, along with all affected projections of NAS demand (2.17).

2.3 SEARCH AND RESCUE

Under today's operations, flight planning information for VFR flights is essential to ensure that search and rescue services are provided when necessary. The search and rescue system is alerted when information is received from any source that an aircraft is overdue, missing, or having difficulty. In 2005, improved emergency locator transmitters (ELTs) are in use with corresponding new standards and rule making. These ELTs utilize discreet codes and satellite based navigation positioning information (2.20) to aid in search and rescue. For aircraft equipped with these systems, the NAS-wide information system either identifies the successful completion of the flight or provides its last known position (2.21). When a flight is overdue and no ELT signal is detected, the flight's information is readily available to search and rescue organizations through the NAS-wide information system to verify the need to initiate search procedures (2.22).

3. AIRPORT SURFACE OPERATIONS AND SERVICES

Surface movement is both the first and last step in a the progress of a flight through the NAS. With no expected increase in the number of available runways or taxiways, the goal of the service provider, now and in 2005, is to remove system constraints on flights moving from pushback to the runway, and from the runway to the gate. Elimination of these constraints in 2005 minimizes the overall ground delay of arrivals and departures through implementation of the following system enhancements (3.3):[3]

- Expansion of datalink capabilities to more users at more airports improves information exchange and coordination activities.
- Increased collaboration and information sharing between users and service providers creates a more realistic picture of airport departure and arrival demand.
- Automation aids for dynamic planning of surface movements provide methods and incentives for collaborative problem-solving by users and service providers. This improves the management of excess demand through balanced taxiway usage and improved sequencing of aircraft to the departure threshold.
- Integration of surface automation with departure and arrival automation facilitates the coordination of all surface activities. Runway and taxiway assignments are based on projected arrival/departure runway loading and surface congestion, user runway preference and gate assignment, and environmental considerations such as noise abatement. Arrival runway and taxiway assignments are planned early in the arrival phase of flight. Departure assignments are made when the flight profile is filed, and updated accordingly until the time of pushback.
- Improved planning that allows flights to depart immediately after de-icing improves both efficiency and safety. Automation to monitor and predict the movement of ground vehicles provides further safety enhancements through improved conflict advisories.

3.1 ENVIRONMENT

Surface movement operations involve numerous activities to maneuver traffic between runways and gates. In performing those activities today, communications and coordination consume most of the service provider's time. In 2005, communications are increasingly automated through the growing availability of datalink, while coordination and planning are aided by new decision support systems. Together, these systems enhance airport safety, improve efficiency and accommodate user preferences (3.5). In addition, airport safety and efficiency is enhanced by terminal weather radar, automated weather observation systems, integrated systems to detect and predict hazardous weather, and improved surface detection equipment (3.6).

The NAS is increasingly integrated as surface-movement decision support systems provide real time data to the NAS-wide information system (3.7). Upon pushback, the flight's time-based trajectory is updated in the NAS-wide information system, based on the average taxi time at the airport under prevailing traffic conditions (3.8). At wheels-up, this trajectory is again updated (3.9). This continuous updating of the flight object improves real-time planning for both the user and the service provider. Real time information also improves the effectiveness of ongoing traffic management initiatives and the collaborative decision making (3.10) involved with any proposed initiatives.

Surface-movement decision support systems are also an integral part of the total NAS automation system (3.11). This ensures that surface initiatives and user preferences are not at cross purposes with information being generated by airspace automation systems. Thus, runway assignments in departure and arrival automation are based not only on the location of the assigned gate, but also on the surface automation's prediction of congestion and the related taxi plan. For departures, taxi time updates and the associated estimates included in the taxi plan are coordinated automatically with airspace automation to efficiently sequence ground traffic to match projected traffic flows aloft (3.12).

[3] This section presents a high-level description of surface movement operations in 2005. This time frame represents the first opportunity to make fundamental changes in the delivery of NAS services. Thus the concepts provided here do not describe an end-state system. Instead, they define that initial change in the air traffic environment, and lay the groundwork for transitional phases after 2005. These transitional phases will expand on the concepts described here, and, building upon 2005 technologies, culminate in an end-state system.

3.2 SERVICES

The services provided in the surface-movement phase of flight include aviation information, separation assurance and traffic management.

3.2.1 Aviation Information

In 2005, changes in aviation information have occurred in three areas: aeronautical information, departure clearance, and surface management information.

Aeronautical information such as NOTAMs and meteorological information for the airport vicinity continue to be acquired by service providers and disseminated to users to aid in their planning and conduct of flight operations. However, this acquisition and dissemination is expedited by the NAS-wide information system (3.15). The Automated Terminal Information Service (ATIS) remains similar to the system of today. But through the use of voice synthesis technology, ATIS messages are no longer manually recorded by service providers, and datalink allows most of these messages to be transmitted digitally (3.18), rather than over communications channels. Weather advisories are handled in a similar fashion (3.19).

Departure clearances are issued via datalink at more airports and to more users (3.20) than is feasible today. In addition, automation functions utilize these departure clearances, along with aircraft location and aircraft type, to generate taxi schedules. Thus departures will be spaced more efficiently than they are today, resulting in reduced taxi times and improved airborne departure traffic flows (3.21).

A surface management information system is fielded at some airports to facilitate coordination between decision-makers at all levels of the airport operation (3.23). This system's processes and displays provide complete data connectivity between the service provider, flight deck, airline operations center, ramp, airport operator, and airport emergency centers (3.24). The system provides access to airport environmental information, arrival, departure, and taxi schedules, airborne and surface surveillance information, flight information, ATIS and other weather information, and traffic management initiatives (3.25). These data are shared with the NAS-wide information system (3.26). At sites where the surface management information system is not fielded, ad-hoc site adaptations can provide basic intra-airport connectivity through the NAS-wide information system (3.27).

3.2.2 Separation Assurance.

Separation assurance on the airport surface in 2005 benefits from increased information to improve situation awareness, support taxi planning, and improve ramp control to match surface movement with the departure and arrival phases of flight (3.28).

Visual cues that service providers currently rely upon are augmented with enhanced situation displays and surface detection equipment (3.29) to improve situation awareness. In addition, service providers can display satellite-derived position data transmitted by selected flights upon request, while ground-based surveillance data is shared with users as a safety enhancement for preventing incursions (3.30). Situation displays are available for airborne and surface traffic, with appropriate overlaps for viewing arriving and departing traffic (3.31). The surface situation display depicts the airport and nearby airspace, with data tags for all flights and vehicles (3.32), resulting in safer, more efficient operations in low visibility.

Taxi planning is significantly improved in 2005, through timely availability of traffic activity information (3.33). In today's environment, the lack of accurate departure information results in taxi and departure delays. These delays are compounded in many cases by multiple flights scheduled for departure at the same time, since taxiway queues are essentially based on first-come, first-served. In 2005, as the aircraft prepares to taxi, service providers use decision support systems to determine taxi sequencing, and to perform conformance monitoring and conflict checking (3.36). Since this automated planning process shares information with the surface situation monitoring systems, the resulting taxi plan balances the efficiency of the movement with the probability it can be executed without change (3.37).

For departures, the decision support system incorporates departure times, aircraft type, wake turbulence criteria, and departure routes to safely and efficiently sequence aircraft to the departure threshold (3.38). For arrivals, the decision support system considers the assigned gate or parking are to minimize taxi time after landing (3.39). Additionally, improved knowledge of aircraft intent allows automatic monitoring of taxi plan execution and provides alerts to the potential for runway incursion (3.40).

In today's environment, the pilot is responsible for pushing back from the gate to meet departure-time constraints, for maneuvering the aircraft to the appropriate taxiway, and for maintaining separation while in transit to the airport movement area. Ramp service providers (either FAA or airline personnel) manage the movement of aircraft across ramp areas to the gates. In 2005, ramp service providers, where used, sequence and meter aircraft movement at gates and on ramps, using situation displays that interface with decision support systems and personnel in the control tower (3.42). Safety is enhanced by these situation displays which include airborne and surface traffic as well as information from the surface management information system. This information aids in sequencing gate arrivals and departures in concert with the taxi planning system.

3.2.3 Traffic Management Services

In 2005, traffic flow service providers oversee the surface automation by analyzing the operational situation and establishing initial parameters for surface movement planning (3.43). In the process, these service providers establish initial taxi-times based on weather and airport configurations, and establish aircraft movement times required to accomplish deicing with minimal delay from station to departure (3.44). The service provider evaluates results and adjusts parameters as needed. Both the initial values and subsequent adjustments are incorporated into the surface management information system (3.45) to ensure consistency and an integrated approach across systems.

for both the user and the service provider. This real time information improves the

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4. DEPARTURE AND ARRIVAL SERVICES

In 2005, departure and arrival operations are characterized by the following:[4]

- Decision support systems increase the efficient use of airport assets by providing assistance in planning taxi sequences and spacing, and in the assignment of aircraft to runways (4.2).
- Departure and arrival route structures are expanded, within environmental constraints, to allow increased usage of area navigation (RNAV), satellite navigation, and routes flown automatically by the onboard Flight Management System (FMS) (4.3).
- Improved procedures eliminate the need for many speed and altitude restrictions, including the 250 knot speed restriction below 10,000 feet (4.4).
- Automatic exchange of information between flight deck and ground-based decision support systems improves the accuracy and coordination of arrival trajectories (4.5). This exchange includes the flight deck's wind and weather information, which is shared with the service provider and other flight decks.
- Increasingly accurate weather displays are available to service providers. In addition, automatic broadcast of hazardous weather alerts for wind shear, microbursts, gust fronts, etc., are delivered simultaneously to the flight deck and service provider (4.6).
- Shared access to the NAS-wide information system allows an automated exchange of gate and runway preference data between the flight deck, the airline operations center, and the flight object (4.7).
- Status information concerning the NAS infrastructure components that support arrival and departure operations is shared with the flight deck (4.8).

4.1 ENVIRONMENT

In 2005, decision support systems assist the service provider in providing runway assignments and in merging and sequencing traffic, based on accurate traffic projections and user preferences (4.9). These systems eliminate today's need for comparatively rigid routing and airspace constraints that limit user flexibility. Tools such as FMS, datalink, and satellite navigation allow the route flexibility by reducing voice communications and increasing navigational precision (4.11). Satellite-based position data, broadcast by properly equipped aircraft, are used in cockpit traffic displays to increase the pilots' situation awareness for aircraft-to-aircraft separation. These avionics allow an increasingly frequent transfer of responsibility for separation assurance to the flight deck for some types of operations (4.12).

Pre-defined data link messages, such as altitude clearances and frequency changes, are uplinked to an increasing number of equipped aircraft (4.14). Voice communications between service providers and pilots are thereby reduced (4.15), giving the service provider additional time for planning functions that help accommodate increased traffic demand. Service providers are further assisted by enhanced ground-to-ground communications systems (both digital and voice) that allow seamless coordination within and between facilities (4.16). As a result, coordination between tower, departure/arrival, and en route service providers is virtually indistinguishable from intra-facility coordination. Finally, disruption in departure and arrival traffic is minimized by improved weather data and displays. Available to service providers and users, these data and displays enhance safety and efficiency by disclosing weather severity and location (4.18).

[4] This section presents a high-level description of departure and arrival operations in 2005. This time frame represents the first opportunity to make fundamental changes in the delivery of NAS services. Therefore, the concepts provided here do not describe an end-state system. Instead, they define that initial change in the air traffic environment, and lay the groundwork for transitional phases subsequent to 2005. These transitional phases will expand on the concepts described here, and, building upon 2005 technologies, culminate in an end-state system.

4.2 SERVICES

The activities associated with the departure and arrival phases of flight include separation assurance, traffic management, navigation/landing services, and airspace management.

4.2.1 Separation Assurance

In 2005, decision support systems help service providers to maintain situation awareness, identify and resolve conflicts, and sequence and space arrival traffic (4.20). As a result, separation assurance has undergone changes in the following areas: aircraft-to-aircraft separation, aircraft-to-airspace and aircraft-to-terrain/obstruction separation, and departure and arrival planning services (4.21).

Aircraft-to-aircraft separation remains the responsibility of service providers in 2005, and, in most traffic situations, it remains *solely* their responsibility (4.22). However, today's practice of visual separation by pilots in terminal areas is expanded in 2005 to allow all-weather pilot separation when deemed appropriate by the service provider (4.23). The increased use of this shared responsibility is made feasible through traffic displays on the flight deck, and rules, procedures, and training programs that have modified the roles and responsibilities of users and service providers (4.24). To assure aircraft separation, service providers utilize improved tools and displays (4.25). Today's situation displays and conflict alert functions have evolved to provide more information, based on expanded data acquisition capabilities and improved trajectory modeling and analysis (4.26). Expanded data acquisition results from inputs by the flight deck, airline operations center, service provider, and interfacing NAS systems. These inputs provide more information concerning traffic status and predictions, status of individual flights, pilot intent, user preferences, and traffic plans generated by upstream and downstream automation systems(4.27). The distribution of this information by improved displays assists the service provider in maintaining situation awareness and in traffic planning (4.28). With these data, improved trajectory models and analyses benefit the service provider through highly accurate conflict detection functions, and reliable conflict resolutions that maximize safety while minimizing traffic disruption. These conflict detection and resolution functions consider arrival and departure traffic throughout terminal airspace, separation at the intersection of converging runways, separation between parallel runways, and separation from ground vehicular traffic on the runways (4.29).

Aircraft-to-airspace and aircraft-to-terrain separation also remains the service provider's responsibility (4.31) in 2005. In this regard, the service provider maintains separation between controlled aircraft and active SUAs, and between controlled aircraft and terrain/obstructions (4.32). An automated safe-altitude warning function enables the service provider to keep aircraft safely above terrain and obstructions (4.33). For airspace separation, accurate information on SUA status and planned usage is disseminated automatically to the service provider through the NAS-wide information system (4.34). This eliminates the numerous coordination calls currently required between facilities, and improves the timeliness and accuracy of the information to the service provider and the user. In addition to airspace and terrain/obstruction avoidance, the service provider has improved tools to assist pilots in avoiding hazardous weather (4.35). Enhanced weather data and weather alerts are output on service provider displays, and simultaneously uplinked for display on the flight deck. These displays improve the service provider's ability to coordinate with the flight deck and with other service providers to ensure the avoidance of hazardous weather (4.36).

Departure and arrival planning services involve the sequencing and spacing of arrivals, and the integration of departures into the airborne traffic environment (4.38). Improved departure flows are achieved through tools that provide more efficient airport surface operations, improved real time assessment of traffic activity in departure and en route airspace, and expanded usage of flexible routes based on RNAV, satellite navigation, and FMS (4.39). Arrival operations also benefit from these tools (4.40), however the service provider's primary task in this phase is to plan and achieve optimum spacing and sequencing of the arrival flow. The runway assignment, which provides the basis for this activity, is made early in the arrival phase of flight (4.41). The user's runway assignment preference is available through the flight object within the NAS information system, and is used in conjunction with departure and arrival decision support systems and the integrated surface management tool to coordinate an optimal assignment (4.42). In the final portion of the arrival phase, decision support systems facilitate the use of time-based metering to maximize airspace and airport capacity (4.43). Other tools generate advisories to the service provider that aid in maneuvering flights onto the final approach in accordance with the planned traffic sequence (4.44). On final approach, the service provider may give the pilot responsibility for station keeping to maintain the required sequence and spacing to the runway (4.45).

4.2.2 Traffic Management Services

The traffic flow service provider in 2005 receives increased assistance from decision support systems for managing arrivals and departures (4.46). Today, these service providers make the plans that will guide arrival and departure activities. But with the increased use of decision support tools in 2005, these service providers focus on establishing the parameters to be used by the support tools, and the tools develop the plan (4.48). In this process, service providers utilize the decision support systems to monitor traffic flows, NAS performance, and weather (4.49). They also use these tools to report on departure/arrival resources, and to identify airspace and airport congestion problems (4.50). This is facilitated by the commonality of information used by tower, arrival/departure, and en route service providers, who have access to identical tools and information regardless of facility.

Improved weather tools and displays are used to assess the effect of weather on departure and arrival airspace capacity (4.52). Through the NAS-wide information system, service providers also remain informed on distant weather conditions in order to anticipate changes to the daily traffic flow, and requests from other facilities (4.53). Data from the NAS-wide information system allows service providers to monitor infrastructure status, staffing, and other conditions in order to anticipate traffic demand and workload, both at their own facility and at others (4.54). This is especially important when working with tower service providers to manage runway configuration changes. Arrival flows and departure queues are planned around projected times for configuration changes that cause the least traffic disruption (4.55). The arrival and departure service providers also update the NAS system information about the capacity of airport and surrounding airspace resources and current status of the area's SUAs (4.56).

When traffic management initiatives are required, service providers collaborate with users to resolve congestion problems through adjustment of user schedules (4.57). If these adjustments do not adequately resolve the problem, the service providers work with the national traffic management function to solicit user input concerning flow constraints, and these constraints are entered into the NAS-wide information system as planned or current operational requirements (4.58).

4.2.3 Navigation/Landing Services

In 2005, the current ground-based navigation systems are in transition to satellite-based systems (4.60). Satellite navigation allows aircraft to fly more flexible routes (4.61), resulting in savings to the user. Approach guidance, currently provided by ground-based systems, is supplemented by satellite-based approaches (4.62) in 2005. Augmentation systems have the accuracy, availability, integrity, and continuity necessary for precision approaches. Separation standards are set in accordance to the accuracy of the positional information (4.63). This transition results in precision approaches being available at more airports, increasing all-weather access to an increasing number of airports (4.64).

4.2.4 Airspace Management

Service providers currently use predetermined routes to manage departure flows. In 2005, more flexible departure routes are possible, within environmental constraints, as more aircraft are equipped with advanced navigation systems, and the service provider has automated support to verify adherence to the selected profile (4.66). These flexible paths comprise a large set of profiles from which the user may choose; however, individually coordinated user-preferred trajectories may also be used. Advance coordination of planned departure routes during the pre-flight phase make more flexible routing possible (4.68).

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5. EN ROUTE/CRUISE OPERATIONS AND SERVICES

In 2005, en route airspace structures and boundary restrictions are unconstrained by communications and computer systems, and aircraft are no longer required to fly directly between navaids along routes defined by the FAA (5.1). As a result, en route operations are characterized by the following:[5]

- Improved decision support tools for conflict detection, resolution, and flow management allow increased accommodation of user-preferred trajectories, schedules, and flight sequences (5.2).
- Traffic flies optimum descent profiles, remaining at higher altitudes for longer periods during the arrival phase of flight (5.3).
- With the completion of the National Airspace Review, the airspace structure is adjusted to meet user needs. Tools and procedures are in place for frequent evaluations of the airspace structure (probably daily), and anticipated traffic flows are accommodated by adjustments to sector boundaries (5.4).
- Automated, seamless coordination and communications within and between facilities enables airspace structure flexibility and reduced boundary restrictions (5.5).
- Structured routes are the exception rather than the rule, and exist only when required to meet continuous high density, to provide for the avoidance of terrain and active SUAs, and to facilitate the transition between areas with differing separation standards (5.6.1). Demand and capacity imbalances are resolved, in collaboration with the users, via voluntary changes in trajectories or through the establishment of temporary routes and transition points in the affected area (5.6.2).
- Surveillance of all positively controlled aircraft is provided by a combination of primary and secondary radar, and the broadcast of satellite-derived position information by individual flights (5.7).
- The NAS-wide information system is continually updated with changes in airspace and route structures, and with the positions and predicted time-based trajectories of the traffic (5.8).

5.1 ENVIRONMENT

The goal in 2005 is to allow turbojet and turboprop aircraft to fly higher, remaining high closer to the airport. This reduces exposure between high and low performance aircraft and releases lower altitude airspace for use by lower performance aircraft (5.9.1). New displays are operational in all en route facilities and the service provider has access to more accurate forecasts of potential conflicts (5.9.2). Decision support systems such as the conflict probe assist the provider in developing safe and effective traffic solutions (5.10). With the potential for reduced separation minima, the decision support systems allow more aircraft to operate on routes according to the most favorable winds, even while traffic demand increases with additional available altitudes (5.11).

En route surveillance is accomplished through a combination of primary radar, beacon interrogation, and broadcasts of aircraft position and speed (5.12). As more forms of position data become available, more traffic is under some form of surveillance (5.13). An increasing number of aircraft are equipped with satellite based navigation, digital communications, and the capability to automatically transmit position data. Many of these aircraft have this capability coupled to an FMS (5.14). Additional pilot intent and aircraft performance data are provided to decision support systems, thus improving the accuracy of trajectory predictions. This information is combined and presented on the service provider's display (5.15). Since there are different separation standards depending on the flight's equipage and the quality of the positional data, service provider displays indicate the quality of the resulting aircraft positions and the appropriate equipage information (5.18).

As a result of these developments, flights routinely operate on user-preferred trajectories, with fewer aircraft constrained to a fixed route structure. These trajectories are accommodated earlier in the flight and

[5] This section presents a high-level description of en route air traffic operations in 2005. This time frame represents the first opportunity to make fundamental changes in the delivery of NAS services. Therefore, the concepts provided here do not describe an end-state system. Instead, they define that initial change in the air traffic environment, and lay the groundwork for transitional phases after 2005. These phases will expand on the concepts described here, and, building upon 2005 technologies, culminate in an end-state system.

continue closer to the destination than is currently allowed (5.19). As ground based navaids phase out with the transition to satellite navigation, the current route structure is replaced with a global grid of named locations (5.20). These defined points are used for coordination, including transition points for flow initiatives, and as backup in the case of airborne or ground based automation failures. Times remain when projected airspace demand is at or near capacity. In these instances, after collaboration between the users and traffic management, temporary routes and associated transition points are identified using the global location grid (5.22). The temporary route structure that prevails at a given time is available to all service providers and users via the NAS-wide information system (5.23).

As in previous portions of flight, complementary digital communication systems enable datalinking of routine communications (5.24) such as frequency changes or certain clearances. This automated coordination reduces the amount of time pilots and service providers spend on routine tasks (5.25), allowing more time to address other issues such as user requests. The pilot in en route airspace has better downstream weather data information in digital form, both through automated means and through request/reply datalink (5.26). More aircraft provide real-time winds and temperatures aloft, resulting in better weather information for forecasting and traffic planning (5.27). Weather data are distributed to decision support systems for processing and presentation to service providers, resulting in a more accurate and common awareness of meteorological conditions (5.28).

5.2 SERVICES

The services provided in the en route area include separation assurance, traffic management and airspace management. The major changes in navigation have been previously addressed.

5.2.1 Separation Assurance

As in the departure and arrival operations, increased decision support allows significant improvement in en route separation assurance (5.30). Changes are seen in both aircraft-to-aircraft separation and in aircraft-to-airspace separation (5.31). In a related area, there is improved coordination between the service provider and the flight deck to aid the flight in weather avoidance (5.32). By using the improved information available from common weather sources, service providers are more effective in controlling aircraft in airspace that contains hazardous weather and in providing weather advisories to pilots (5.33).

In 2005, service providers continue to issue control instructions to aircraft in order to maintain separation (5.34). Decision support systems assist in conflict detection and the development of conflict resolutions (5.35). This reduces mental workload and gives the provider more time for other tasks such as responding to user requests. Improving the provider's ability to identify conflicts also reduces the number of occasions when there is intervention, allowing the user to fly the trajectory proposed with higher frequency (5.37). Use of paper flight strips is eliminated since decision support systems display necessary information (5.38).

The availability of flight data for all flights via the NAS-wide information system improves the ability of the service provider to issue traffic advisories to controlled aircraft about uncontrolled aircraft(5.39). There are also improved flight following services for VFR traffic (5.40). For VFR aircraft automatically reporting their satellite-derived positions, the inclusion of that information, coupled with access to the flight's data via the NAS-wide information system, reduces the workload associated with providing traffic advisories to uncontrolled aircraft (5.41).

Service providers are also responsible for maintaining separation between aircraft and certain types of airspace (specifically, active special use and adjacent controlled airspace), terrain, and obstructions(5.42). The activation of a SUA results in the reevaluation of all flight trajectories in the NAS-wide information system, to determine which flights will penetrate the SUA (5.43). This results in earlier intervention and negotiation of new trajectories or airspace solutions. When flights are in close proximity to the newly activated SUA, the provider uses aircraft-to-aircraft conflict detection tools as aids to prevent them from entering the restricted airspace. Both earlier intervention and the closer-proximity resolution activities result in more efficient routing of aircraft (5.45). Decision support tools also help service providers to collaborate with users when SUA restrictions are later removed or changed (5.46).

5.2.2 Traffic Flow Management

In 2005, the traffic flow service provider's role has changed to include coordination of dynamic airspace structuring, more strategic management of traffic, coordination of new trajectories, and the management of major flows(5.47).

As in the departure and arrival phase, the service provider has access to the NAS-wide information system which includes weather information, infrastructure status, and other conditions in the NAS(5.48). The provider also has access to a predicted demand profile for the entire day (5.49). The profile is produced through improved information sharing, collaborative decision making, and the projection of flows based on weather and wind patterns (5.50). This information is used, in coordination with the national flow management and other en route traffic flow facilities, to determine the daily airspace structure (5.51). Any capacity problems due to SUA schedules, staffing, or weather are identified (5.52). In coordination with national flow management, and with the user, alternatives for managing potential problems are explored (5.53). These may include voluntary splitting of flows by the user to reduce demand, or by identifying potential route structures and transition points for moving to and from user preferred trajectories. The service provider is given demand forecasts throughout the day via the continually updated NAS-wide information system (5.55). As conditions change, initiatives are reviewed and adjustments made, through coordination with all affected facilities and users (5.56).

The traffic flow service provider has the same tools as those providing separation assurance (5.57). By resetting parameters (such as conflict detection look-ahead time) the probe becomes a density tool which the service provider uses to identify areas and times of higher density (5.58). By working strategically with upstream separation assurance providers and the users, some density problems are mitigated (5.59) with minimal impact on the users and without the need to move to more formal traffic flow initiatives.

The service provider is also involved in the coordination of modified flight trajectories for active flights (5.60). The use of the NAS-wide information system and the flight object means that any changes in the NAS airspace structure, including activation of SUA or the need to create temporary route structures, ripple back through the information system and identify all flights whose trajectories penetrate the changed airspace (5.61). This allows early and immediate coordination with either the pilot or the airline operations center to provide adjustments with minimal intervention and movement (5.62). Traffic flow service providers work with the service provider in active communication with the pilot to replan the flight trajectory (5.63). Modified trajectories can be also be developed collaboratively with the airline operations center and distributed to the flight deck via datalink, and to downstream facilities via the NAS-wide information system (5.64).

En route service providers currently use a variety of specific flow constraints to manage traffic departing from or landing at underlying airports, and transiting their portion of en route airspace. In 2005, the increased information exchange between the en route, arrival, departure and surface decision support tools enables better coordination of cross-facility traffic flows with fewer constraints. These improved capabilities also allow for greater accommodation of user requests, including carrier preferences on the sequencing of their arrival aircraft(5.66).

5.2.3 Airspace Management

Today, sector changes are the result of combining and decombining sectors to reflect the changes of traffic loads throughout the day, or they are the end product of a long review and design process. With the completion of the National Airspace Review, airspace is redesigned to meet future traffic requirements. In 2005, static restrictions due to fixed sector boundaries are reduced or eliminated (5.70). The airspace structure is frequently evaluated and adjusted in anticipation of expected traffic flows, or in response to weather and NAS infrastructure changes (5.71). Additionally, facility boundaries are adjusted to accommodate dynamic changes in airspace structure (5.72). This flexibility of sector and facility structure is accommodated by improved coordination and communication within and between facilities (5.73).

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6. OCEANIC OPERATIONS AND SERVICES

In 2005, the greatest percentage increase in air traffic is projected to occur across the Atlantic and Pacific Oceans. To accommodate this growth, improvements in navigation, communication and the use of surveillance are paramount enablers of capacity enhancement in oceanic airspace (6.2). Additionally, procedural reductions in separation standards are facilitated through the improved infrastructure (6.3). Automation and procedural changes help service providers to be strategic in solving potential conflicts, traffic congestion, and demand for user preferred trajectories (6.4). Oceanic separation minima are significantly reduced (6.5), allowing a corresponding increase in traffic demand, due to the following improvements:[6]

- Satellite navigation systems and datalink allow more accurate and frequent traffic position updates; datalink and expanded radio coverage provide direct air-to-ground communications (both digital and voice) (6.6).
- Real time position data and continuously updated trajectory projections virtually eliminate manual control procedures in Oceanic airspace. As a result, Oceanic separation standards and procedures are derived from radar control techniques (6.7).
- Rapid delivery of clearances by the service providers, and responses by the flight deck, are achieved through increasingly common use of datalink (6.8).
- Route and airspace flexibility is achieved as Oceanic airspace is integrated into the global grid of named locations. This flexibility is maximized through seamless coordination within and between facilities (6.9).
- NAS Oceanic airspace is standardized to other NAS-International Civil Aviation Organization (ICAO) oceanic systems. Data are presented to service providers in all oceanic systems in a similar format, thus minimizing translation by the provider (6.10).

6.1 ENVIRONMENT

In today's environment, oceanic airspace capacity is limited by separation standards and established route structure. These limitations are necessitated by lack of surveillance and communication coverage in the oceanic airspace. Oceanic service providers rely on periodic aircraft position reports relayed via a commercial service provider to all the oceanic ATC facilities. Because oceanic airspace lacks independent surveillance and real-time communication exchange between the pilot and oceanic service provider, navigation errors can be left undetected by the service provider. A user request for clearance to support a more efficient speed, route or flight level can be denied because data is not accurate enough to assess whether nearby traffic poses a threat of conflict. The communication system, which imposes lengthy delays and limited message length, also impedes the pilot's ability to negotiate revised clearances during flight. The net effect is limited opportunity for granting clearances other than for vacant slots within the track systems.

In 2005, reduced separation minima and dynamic management of route structures help the user formulate and request a preferred flight profile (6.12). Most aircraft navigate using a global satellite navigation system whose improved accuracy generates the required safety for reduced separation standards (6.13). The combination of satellite-based communications and electronic message routing enables the oceanic system to be more interactive and dynamic, supporting cooperative activities among flight crews, AOCs, and service providers (6.14). Service providers use visual displays to monitor the traffic situation (6.15). NAS oceanic service providers coordinate with their oceanic neighbors to agree on a common set of rules and operational procedures for a harmonized oceanic system (6.16), meeting the challenge of international collaboration in day-to-day activities.

Procedures for flight planning in U.S. domestic and oceanic airspace is identical in 2005. Flight planning into non-U.S. airspace also evolves in concert with ICAO procedures (6.17). Differences between

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separation standards, data processing protocols and other technological issues are worked toward a harmonized conclusion.

6.2 SERVICES

The services provided in the ocean include separation assurance and traffic and airspace management.

6.2.1 Separation Assurance

Changes in both aircraft-to-aircraft and aircraft-to-airspace separation assurance occur in 2005 (6.20). The oceanic service provider has a display of traffic in the oceanic airspace, ensuring separation in the same manner as in domestic airspace, although the separation criteria may be different (6.21). In addition, the oceanic environment creates opportunity for the transfer of separation assurance to the pilot for specific operations (6.22). Pilots have situation awareness of nearby traffic through a cockpit display of traffic information (6.23). Aircraft position updates are supplied by the aircraft's broadcast of satellite navigation-derived position data transmissions (6.24). To maximize flight efficiency, pilots may coordinate with service providers for clearance to conduct specified maneuvers while the pilot's view of nearby traffic supplements the service provider's big picture of longer term traffic flow (6.25). When operationally advantageous, pilots may obtain approval for special maneuvers such as station keeping with reduced spacing (6.26). The pilot's ability to support climbs, descents, crossing and merging routes is supplemented by the service provider's conflict probe decision support system (6.27).

The oceanic service provider benefits from use of the same type of decision support tools available to help en route service providerS in 2005. Such tools aid in detecting and resolving possible conflicts, and preventing controlled aircraft from entering restricted airspace(6.28). Aircraft crossing Air Defense boundaries are reported to the appropriate military entity (6.30). Coordination and exchange of information between sectors is automated (6.31) to increase productivity and efficiency of service providers.

6.2.2 Traffic and Airspace Management

The service provider's role in developing daily oceanic tracks changes in 2005. Full surveillance, better navigation tools, real-time communications and automated data exchange between the pilot and service provider via datalink facilitate the transition away from tracks and toward trajectories in oceanic airspace (6.33). The airspace structure may change dynamically based on weather, demand and user preferences (6.34). These changes are coordinated with all affected national and international traffic flow service providers via electronic data transfer (6.35). Service providers, aided by supporting automation and electronic visual displays, are able to acquire and view timely and reliable flight information to dynamically address necessary changes to the airspace or trajectories (6.36).

Adjustments must be made to the airspace structure and/or trajectories when demand exceeds capacity (6.37). In oceanic airspace, these changes are coordinated with national and international traffic flow service providers (6.38). The service provider has access to the NAS-wide information system as well as projected demand for the day (6.39). The NAS service provider collaborates with international service providers to determine the daily airspace structure, identify and explore alternatives to potential capacity problems, and manage traffic over fixes including gateway entries (6.40).

7. NAS MANAGEMENT

In 2005, NAS infrastructure management and air traffic management are creating an environment of user flexibility, collaborative partnership, and information sharing among themselves and with their users (7.1). Through collaborative decision making, service providers in 2005 focus on providing the best, seamless service to users (7.2).

7.1 NATIONAL TRAFFIC MANAGEMENT

7.1.1 Traffic Flow Management

The NAS includes an executive flow unit dedicated to system-wide/international planning and coordination, called the Air Traffic Control System Command Center (ATCSCC). In 2005, air traffic service providers at the ATCSCC monitor traffic, weather and infrastructure across the NAS (7.5). They also manage and implement broad scope traffic restrictions, facilitate coordination among other domestic/international service providers, and interact with AOC facilities and other NAS user organizations (7.6). Continuous evaluation of traffic management initiatives, to determine their effectiveness and their impact on users, is the focus of these activities(7.7). ATCSCC service providers monitor NAS performance and adjust traffic management strategies as needed (7.8).

2005 national traffic flow management is characterized by the following:

- Increased automated information exchange among domestic/international service providers, and between service providers and users, supports seamless global air traffic management (7.10).
- Increased collaboration between service providers and users in problem resolution improves overall system effectiveness (7.11).
- Enhanced decision support systems improve NAS monitoring, performance measurement, and strategy development (7.12).
- Automation and decision support capabilities tailored for the ATCSCC provide a global perspective and facilitate coordination among local and national traffic flow managers to improve decision making (7.13).
- Dynamic airspace is collaboratively managed (7.14).

7.1.2 Infrastructure Management

The overriding objective of NAS Infrastructure Management is to enhance the efficiency and effectiveness of NAS infrastructure service delivery. Fundamental to the management concept is the belief that effective service must be provided on the basis of user priorities through shared information and decision making (7.16).

The availability of new technology provides opportunities for major technology infusion to enhance infrastructure management (7.17). Innovative ways of managing the NAS infrastructure emerge from new computing and communications capabilities, increased equipment and system self-monitoring and self-restoration, enhanced networking, and expanded use of remote monitoring and control(7.18). The new technologies, however, also require new management methods and operations processes to capitalize on the opportunities (7.19). Such technologies and management methods form the key characteristics for 2005 infrastructure operations described below:

- Infrastructure operations and maintenance (O&M) are performed from the viewpoint of customer requirements for the services, with an understanding of the effects of O&M activities on service delivery to NAS infrastructure users (7.21).
- Close collaboration with infrastructure users ensures that the right service and priority is applied to service delivery (7.22).

- Infrastructure operations are performed from a national perspective (7.23). This approach ensures that uniform, nationwide procedures are applied and infrastructure activities managed on a broad view basis of impact across the NAS.
- Full-time monitoring and control of NAS infrastructure service delivery and systems functioning is provided for efficient service and systems management (7.24).
- Remote monitoring and control is increasingly used to enhance timeliness of response to infrastructure user needs, and increase efficiency in the use of field personnel (7.25).
- In-depth NAS infrastructure management expertise is consolidated to provide rapid, effective response to infrastructure user needs, and effect efficiencies (7.26).
- Information collection and exchange, automated decision support, and remote monitoring and control systems are effectively integrated (7.27).

7.2 ENVIRONMENT

7.2.1 Traffic Flow Management

In 2005, users are better able to plan their flight operations in anticipation of NAS capacity and traffic conditions, and to minimize congestion or possible delays due to the comprehensive information made available by the NAS-wide information system (7.28). This system includes up to date information such as capacity and aggregate demand at airports and other NAS resources, airport field conditions, traffic management initiatives in effect, and Special Use Airspace status.

ATCSCC service providers collaborate with domestic and international service providers, including other executive flow units, to provide for end-to-end flight planning predictability (7.29). Traffic flow management employs the philosophy of problem resolution at the lowest level possible (7.30). The ATCSCC provides oversight to minimize system impact and equitably distribute the impact to the users (7.31). Collaboration is used to negotiate a revised flight trajectory, in real-time (7.32).

In 2005, increased collaboration among local facilities, the ATCSCC and NAS users is augmented by decision support systems that enable a shared view of traffic and weather with all parties (7.33). In addition, "what-if" tools for both the service provider and the NAS user allow proposed strategies to be evaluated (7.34). Because NAS users have increased flexibility in planning routes and schedules in 2005, and because the NAS relies less on routine restrictions and fixed routes to structure traffic, managing NAS resources becomes more dynamic and adaptive (7.35). Improved decision support systems help service providers visualize demand and manage the more complex traffic flows (7.36). In addition, decision support systems that evaluate NAS performance in real-time enable the service provider to be more responsive and to develop more effective traffic management strategies (7.37).

7.2.2 Infrastructure

The infrastructure and traffic flow management collaborate closely with air traffic service providers (7.38). Air traffic service providers not only have a point-of-contact for system trouble reports but are kept aware of system status and the status of trouble reports (7.39). The infrastructure service provider responsible for resolving a particular problem is available for immediate communication with the air traffic service provider (7.40), with the goal of joint decision making and providing timely service delivery.

Acting under guidance from the national center, infrastructure management service providers assure NAS infrastructure service delivery by directing and prioritizing infrastructure management from a user perspective. They monitor the NAS infrastructure performance and determine actions needed (7.41). Some infrastructure management service providers perform remote management of systems, others perform on-site maintenance for fault correction, preventive maintenance, and equipment installation and removal (7.42).

7.3 NATIONAL TRAFFIC MANAGEMENT OPERATIONS AND SERVICES

7.3.1 Traffic Flow Management

Service providers at the ATCSCC develop a NAS-wide understanding of conditions, capacity, and traffic flow to serve as a central point-of-contact for NAS users and local service providers (7.43). They use the NAS-wide information system to manage information about current and predicted NAS conditions as well as past performance (7.44). The ATCSCC utilizes broader information on international traffic and aviation equipment in support of global traffic flow management (7.45).

Because local service providers have access to the NAS-wide information system, projected demand for the day, and tools to strategically identify areas and times of higher density, traffic flow management issues can be efficiently resolved at the local level (7.46). In coordination with the national flow management, and in collaboration with the user, local traffic flow management explores alternatives for managing the potential problems (7.47). The ATCSCC stays informed about traffic flow restrictions initiated locally (7.48). Working with service providers at terminal and en route facilities, the ATCSCC also initiates and coordinates traffic flow restrictions of a broad scope, strategic or tactical, depending on the situation (7.49). ATCSCC service providers also play a lead role in improving overall NAS service by managing national programs that modify national procedures and techniques governing daily operations (7.50).

Keeping abreast of NAS status and local traffic management initiatives is efficiently done with the NAS-wide information system (7.51) in 2005. Less time is spent on status checking, allowing service providers and users to focus on analyzing situations and on coordinating traffic management strategies (7.52). Service providers at the ATCSCC develop a composite understanding of NAS weather and capacity conditions and make appropriate updates to the NAS-wide information system (7.53). To this end, service providers at the ATCSCC monitor multi-source weather information, including displays integrating weather and traffic information. This information incorporates data provided by NAS users, and is used to predict NAS element capacities and traffic flow patterns (7.54).

The demand-capacity balance of major traffic flows across the NAS is monitored by the ATCSCC with a broader strategic focus than local service providers. Particular attention is given to departure and arrival demand and runway configurations at major airports, SUA active status and schedules, special events, and en route traffic volume. This monitoring activity at the ATCSCC makes extensive use of predictive capabilities, enhanced in 2005 by more comprehensive and current information from users and international service providers (7.57). Revisions to schedules and routes are included in this set of information. For example, the ATCSCC receives flight cancellation information at the same time as an airport. They also receive information identifying how quickly the next aircraft would be available for takeoff (e.g., which aircraft have pushed back) (7.58). It is the responsibility of service providers at local facilities to set such capacity measures as airport arrival acceptance rates (7.59).

Information about arrival capacity allocations, reroute programs and other restrictions is automatically recorded, as is information from local facilities (7.60). The recorded information includes both predicted and actual conditions. Service providers at the ATCSCC coordinate with local service providers as needed to verify information about, anticipated congestion, delays, and/or other adverse situations (7.61).

To anticipate where and when demand might exceed capacity, both local and national traffic flow managers rely on decision support systems (7.62). For example, areas and times of high demand across the NAS are predicted by identifying optimal wind routes, determined through analysis of upper air winds information. A decision support system helps the service provider evaluate the impact of proposed strategies on the NAS by identifying options for avoiding problematic traffic situations.

The NAS-wide information system makes information available to all service providers for a common understanding of situations. Hence, they can collaboratively plan strategies that are not only more responsive to the situation, but also consider the needs of the entire NAS (7.64). User flexibility is significantly expanded by advance information about demand and capacity. The information allows users to avoid delays or other consequences by revising their plans in a timely manner (7.65).

ATCSCC service providers continue to manage capacity control programs (CCPs); however, more accurate, real-time data and user collaboration reduce the frequency of such initiatives. The programs are primarily used in the case of infrastructure outages or inclement weather (7.66). When CCPs are necessary, the user assumes responsibility for adhering to allocated arrival times. In some instances international flights will be included in CCP's, providing for a more equitable distribution of impact and increasing the users options for time slot substitutions (7.68). Decision support systems aid the ATCSCC in monitoring user adherence to arrival times (7.69).

To resolve recurrent traffic flow problems, ATCSCC service providers utilize improved automation capabilities for monitoring, measuring and reporting NAS performance (7.70). This automation includes decision support systems for developing alternative airspace designs, simulating traffic through the NAS for each airspace structure proposal, and evaluating each proposal. Resolution of recurrent problems may include inter-facility coordination to analyze operational data, develop procedural changes, and negotiate with NAS users and local service providers (7.71). The analysis of NAS operations includes an assessment of the general effectiveness and fairness of flow constraints (7.72). Information from the analysis is entered into the NAS-wide information system and helps identify compliance issues and incentives to improve collaborative flow planning (7.73).

7.3.2 Infrastructure

NAS service delivery refers to the management of NAS equipment, facilities, systems, and the services they provide. Managing services ultimately relies on managing systems and their component elements (7.74). These system management activities are effectively performed by a prioritization scheme and responsiveness based on service performance needs (7.76). For example, response and recovery times for air traffic decision support systems support the air traffic services provider's reliance on automation, given the direction toward a paperless environment in 2005.

NAS infrastructure services include communications, navigation, surveillance, weather, decision support, and environmental services (7.77). Some infrastructure services such as navigation and landing signals, and aeronautical information broadcasts are provided directly to FAA customers (7.78).

8. MANAGEMENT

The approach to operations management will shift to a paradigm where managers have local control over resources, and use an automated information management system to access and analyze data (8.1). Operations management in 2005 is characterized by the following:

- Managers have the necessary fiscal and personnel resources to accomplish their mission, and the authority to allocate resources as needed (8.3).
- A management information system provides automated access to management data about NAS operations and infrastructure. It integrates with a decision support system to aid in managing the budget, personnel and operations (8.4).
- The management structure is tailored to promote the efficiency of the operation.

8.1 ENVIRONMENT

Operational managers work autonomously, with less management oversight from outside the facility (8.6) in 2005. Managers have the personnel and fiscal resources, and the flexibility to allocate those resources. Given this flexibility, managers are responsible and accountable for the effective, efficient operations of their respective units. Business operations are more effectively managed and monitored by easy access to, and analysis of data through a management information system (8.8). The management information system is national in scope, providing information about the operations of all FAA operational facilities (8.9). This allows managers to benchmark their operations against other facilities, and allows the FAA to understand and compare the operational and fiscal efficiency of all facilities (8.10).

The management information system provides access to a database integrated with executive decision support tools for managing the budget and analyzing the cost of operations (8.11). Information such as cost of operating the facility, personnel and overhead costs, overtime, labor-management relations, and adherence to schedules can be extracted. Based on the analyses, the manager can make educated decisions about resource allocation and operational efficiency (8.12).

8.2 MANAGEMENT OPERATIONS AND SERVICES

To promote efficiency of the services, roles and responsibilities of managers change (8.13). For example, although the primary role of the first line supervisor continues to be one of providing operations management support, roles and responsibilities expand to account for ongoing changes to the management structure. Management resources such as training, administration support and labor relations are pooled across organizational boundaries for an equitable distribution (8.14). In order to make the operation efficient and successful, one facility manager is accountable for the air traffic services run at the respective field unit and the infrastructure management support that makes the operations possible (8.15). The manager is skilled in business operations, and has the necessary lower level operational and technical management support to run the operation. To support the new demands on managers, appropriate training is provided to ensure that managers have the necessary knowledge, skills, and abilities to perform the range of management tasks and decision making activities expected (8.17). Although the scope of management activities expands, the span of control and duties are limited to those necessary to support the operation.

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